The STS-110 FRR convened at 9 a.m. on Tuesday, March 26, 2002, in the Mission Briefing Room at the Kennedy Space Center (KSC). The meeting was chaired by F. Gregory, Associate Administrator, Office of Space Flight.

Flight Crew, Ferry Readiness, Range, and DDMS did not have any issues or constraints to flight and did not make formal presentations. Readiness statements submitted were included in the backup package.

The STS-110 FRR presenters were:

Mission Operations - R. Castle (NASA/JSC/DA8)
J. Hanley (NASA/JSC/DA8)
T. Sobchak (NASA/GSFC/450)
S. Hartwig (USA/Houston/DF63)
EVA - H. Mitchell (NASA/JSC/XA)
G. Lutz (NASA/JSC/XA)
Space and Life Sciences - C. Fischer (NASA/JSC/SD)
Program Integration - V. Ellerbe (NASA/JSC/MA2)
R. White (USA/Houston/USH-700C)
L. Austin (NASA/JSC/MS)
International Space Station - B. Sellari (NASA/JSC/OC)
S. Walker (NASA/JSC/OB)
M. Wood (Boeing/JSC/HB2-20)
B. Stubbings (NASA/JSC/XA)
E. Castro (NASA/JSC/OB)
P. Thomas (Boeing/Houston/JHOU-2340)
W. Markey (CSA/JSC/OR/CSA)
L. Ramon (Boeing/JSC/HM6-20)
R. Castle (NASA/JSC/DA8)
Payload Processing - B. Jimenea (NASA/KSC/UB-M)
External Tank - R. Wetmore (LMSSC/MAF/3000)
RSRM - M. Rudolphi (NASA/MSFC/MP51)
SRB - S. Gordon (USA/KSC/USK-800)
SSME - G. Hopson (NASA/MSFC/MP21)
J. Price (Pratt Whitney/Palm Beach)
D. Wineland (Rocketdyne/Canoga Park/AC38)
Vehicle Engineering - R. Roe (NASA/JSC/MV)
D. White (USA/Houston/USH-601M)
P. Thornton (USA/Houston/USH-632)
Shuttle Processing - J. Vevera (USA/KSC/USK-229)
M. Madden (USA/KSC/USK-459)
M. Leinbach (NASA/KSC/PH)
SR&QA - M. Erminger (NASA/JSC/MQ)

Mission Operations

The Mission Overview included the Shuttle Overview, Cargo Bay Layout, Mission Priorities and the Flight Overview. The Space Communications and Data Systems presented the Space Network supported launches and the significant changes and test activities. The significant changes included the Air Force Remote Tracking Sites, the NASA Integrated Services Network Russian Space Agency Interface and the Goddard Space Flight Center Flight Dynamics Facility. The significant test activities included the modular memory unit, and the new digital television equipment developed at Johnson

Space Center for Space Transportation System and International Space Station (ISS). United Space Alliance Flight Operations presented the facilities readiness, which included the Mission Control Center and the Flight Design and Dynamics. Mission Operations is ready to support the STS-110 flight.

Extravehicular Activity (EVA)
EVA presented the mission overview, Extravehicular Mobility Unit (EMU) logistics, EMU/ Simplified Aid for EVA Rescue Logistics, the EVA tools and crew aids manifest summary, and the fit checks status. There were four significant STS-109 anomalies presented: (1) the ISS-4 battery charger "Lo Slope" error message, which is not a constraint to flight; (2) the Space Station Remote Manipulator System (SSRMS) wrist roll, which will be discussed by the ISS Program Office; (3) the metox odor during stage Utilization Flight 1, which was addressed. The crew procedures have been modified to avoid reoccurrence; and (4) EMU leaked water during prebreathe operations in the orbiter airlock. A work-around exists in the event this anomaly reoccurs. The EVA Project Office is ready to proceed with the launch of STS-110.

Space and Life Sciences
Crew health was presented. The Detailed Supplementary Objectives for in-flight and pre/post flight were presented. All remaining open work has been planned and scheduled. The EVA pre-breath considerations, the radiation analysis and dosimetry support, and the space weather activity summary and forecast were also presented. Space and Life Sciences is ready to support STS-110.

Program Integration
The key program considerations and the Payload and System safety were presented. One special topic was presented on the Shuttle Certification for Block II Space Shuttle Main Engine (SSME). This will be the first flight to fly three Block II SSME's. The STS-110 NASA System Integration Technical Management Representative discussed the Boeing relocation status as related to the Systems Integration Certificate of Flight Readiness (CoFR). Pending completion of the defined open work, Program Integration is ready for flight.

International Space Station Program (ISSP)
The mission overview included the 8A program reviews, the Increment 4 accomplishments completed prior to 8A, the Increment 4 overview and objectives, the flight overview, which included the significant hardware and the mission priorities, the consumables status and the 8A Launch Commit Criteria. Also presented was the hardware status, out of configuration items, Beta Gimbal Assembly status, Internal Thermal Control System contamination and the direct current-to-direct current converter unit misconfiguration. The following current on-orbit status was presented on the Command and Data Handling, the Communications and Tracking, the Environmental Control and Life Support, the Electrical Power Supply, the Structures and Mechanisms, the Thermal Control System, the Extravehicular Robotics, and the Guidance, Navigation, and Control.

The mated quick disconnect (QD) hydraulic lockup problem was presented with the following conclusions and recommendations: negligible impact to system performance and minimal impacts to EVA timelines, good confidence in completing the tools and devices in time for actual use, and reverification of QD configuration and usage prior to activation. A waiver was approved to address increased spring cavity maximum design pressure and use of single seal operations. This problem is acceptable for flight.

The 8A open paper status was presented. The Avionics and Software Element overview was presented. The Avionics Hardware included the following: Communications and Tracking three video switches deployed, Guidance Navigation and Control two rate gyro

assemblies deployed, Guidance Navigation and Control four Global Positioning Satellite antennas deployed, Command and Data Handling, and the Command and Data Handling software architecture. The new flight software functionality, Mobile Servicing System and Station Program notes were presented. The Avionics and software integrated test activities and the operations support and laboratories status were also presented. The Avionics and Software community endorses the readiness for 8A.

The Canadian Space Agency presented an overview of the Canadarm 2 configuration and functionality, the wrist roll joint failure signature and troubleshooting, the possible causes and corrective actions, and the future work. There was an ISSP CoFR Exception on the Canadarm 2 due to the failure in the wrist roll joint. Closure is pending completion, delivery and on-orbit verification of the six degree of freedom software patch. Closure is due at the STS-110 Prelaunch Mission Management Team (PMMT) Review on April 2, 2002. The following 8A and the SSRMS topics were presented: the goals, the solutions found, EVA impacts, training impacts, schedules, open work and recommendations.

The berthing loads summary was presented, which included the issue description, background, summary and conclusion.

With the completion of open work and the closure of the exception, the ISSP is ready to proceed with the launch of ISS 8A/STS-110.

Payload Processing

The processing milestone, middeck experiment requirements and the engineering status were presented. Pending resolution of identified constraints and completion of open work, the KSC ISS/Payloads Processing Directorate is ready to proceed with launch of ISS-8A/STS-110.

External Tank (ET)

There was one processing anomaly presented. The ET-114 intertank was damaged due to the intertank access arm extensible platform interference. Visual inspection showed no evidence of crack or crack-like defects. The damaged/trimmed foam area will be repaired. Rationale for acceptance was presented. The ET is certified and ready for STS-110 flight pending completion/closure of open and planned work.

Reusable Solid Rocket Motor (RSRM)

The previous flight assessment for STS-109 was presented. There are no constraints to STS-110. Pending satisfactory completion of normal operations the RSRM hardware is ready to support flight for mission STS-110.

Solid Rocket Booster (SRB)

There was one special topic presented on the hydraulic pump bolt torque preload. A new observation on this topic was presented. The right hand SRB tilt hydraulic pump contains three replaced inserts, which were replaced due to the documented raised condition. The concern is the replacement of the raised insert could result in no preload in the joint, which was not covered by the STS-109 flight rationale. Corrective actions are in work and the vendor is under a stop work order until their process can be reviewed. Flight rationale was presented. Pending completion of planned open work, hydraulic pump replacement and successful pump retest, there are no constraints to flight for STS-110.

Space Shuttle Main Engine (SSME)

The SSME propellant flow schematic, the Block I and II High Pressure Fuel Turbo Pump (HPFTP) schematic and the principal causes of pump damage were presented. HPFTP's support full Block II SSME implementation beginning with this launch. The following engine performance was presented: the Block II demonstrated hot-fire

experience, the Block II HPFTP test experience, and the High Pressure Oxidizer Turbo Pump (HPOTP) met all operational objectives. The SSME major components, the Block II SSME engine ready limit change, the predicted SSME ignition confirm margins, and the predicted SSME performance and redline margins were presented.

There were two special topics presented. The first topic was the HPFTP turbine exit diffuser cracks, which could result in turbine bypass. The second topic was the HPFTP/HPOTP turbine blade shot peen process. The supplier changed the shot peen media without Engineering System Assembly approval. Flight rationale was presented for both of these topics.

There was one walk-on CoFR Exception discussed - the HPFTP (unit 8027) was found to have contamination in the turbine coolant passages after the green run test. Two actions are in work to develop final flight rationale: (1) contamination sample was returned to Canoga Park for analysis, and (2) the HPFTP unit 8027 was removed and returned to West Palm Beach for disassembly inspection. The analysis identified the contamination to be non-metallic. This CoFR Exception closure is due at the STS-110 PMMT Review.

Pending closure of the exception, the Atlantis main engines are ready to support STS-110.

Vehicle Engineering

The Boeing relocation status included the critical skills transition process, the Boeing Orbiter and Flight Software relocation status, the Orbiter and Flight Software STS-110 CoFR and conclusions.

There were seven STS-109 In-Flight Anomalies presented: (1) freon coolant loop 1 degraded aft cold plate flow, (2) airlock A hatch locking device difficult to actuate, (3) main propulsion system liquid hydrogen 4-Inch recirculation disconnect slow to close, (4) forward translation hand control-X contact lost during one burn, (5) flash evaporator system actuator/hi-load feedline B heater system 2 failure, (6) primary reaction control system thruster R3R failed off, and (7) extravehicular 1 EMU water leak. There were four OV-104 In-Flight Anomalies presented: (1) forward bulkhead floodlight coldplate return line low temperature, (2) flash evaporator system hi-load and accumulator feedline A system 1 heater failed off, (3) loss of ku-band forward link, and (4) vent door 8 and 9 limit switch anomaly. All these have been reviewed and none constrain STS-110 flight.

There were three critical process changes presented: (1) Operational Maintenance Requirements and Specification Document change with the Orbiter Maneuvering System Engine Preventative Maintenance at Orbiter Maintenance Down Period, and (2) two Engineering Design Change Proposal changes, both within the Vernier Reaction Control System o-ring material.

There are twenty-four modifications incorporated during the STS-110 processing flow. There are five modifications flying for the first time: the EMU dual power supply and battery charger upgrade, the felt reusable surface insulation plugs for erosion prevention, the inboard elevon blade seal, the nose landing gear thermal barriers, and the modular memory unit upgrade. The status of the dedicated signal conditioner transistor failures was presented. The risk assessment for these transistor failures concluded that failure impact is minimized by subsystem redundancy.

Two special topics were presented. The first topic was the aft master events controller (AMEC) output drivers failure indication. The OV-104 AMEC has successfully flown three missions and is acceptable for flight. The second topic was the connector saver concern. The locking feature on the monoball production break connector savers became

disengaged after applying an axial load to the connector saver. This issue is considered a constraint for launch. A CoFR Exception was written against this issue and closure is due at the STS-110 PMMT Review.

The Digital Television Configuration 1 system description was presented. This new system functionally replaces the existing analog camcorders and video tape recorders with improved video quality and editing capabilities.

The STS-110 software summary, major new capabilities for Primary Avionics Software System, Backup Flight Software and Multifunction Electronic Display System, the I-Load patches, data patches and code patch were all presented. With the completion of standard open work, Flight Software is ready to fly.

There were two other CoFR Exceptions discussed. One CoFR Exception was on the orbiter/ET door power drive unit torque limiters, which are suspected of having undersize ball bearings installed in the mechanism. The other CoFR Exception was on six bolts used in the fuel discharge line installed on OV-104 left hand Orbiter Maneuvering System engine. These bolts might have been overstressed during assembly of the joint at White Sands Test Facility. Both of these exceptions will be readdressed at the STS-110 PMMT Review.

Pending resolution of the open CoFR Exceptions, Vehicle Engineering is ready to fly STS-110.

Shuttle Processing

The processing differences and the integrated operations assessment summary were presented. One Shuttle Engineering topic was presented on the Ground Launch Sequencer. One walk-on topic on the ET Hydrogen Umbilical Retract Anomaly (STS-108) was presented. The hydrogen vent arm has been tested, validated and is ready to support STS-110. Also presented were the launch countdown turnaround options and the landing operations status. With the completion of planned work and resolution of any identified constraints, KSC Shuttle Processing and supporting organizations are ready to support launch operations.

Safety, Reliability and Quality Assurance (SR&QA)

Significant assessments performed/supported by SR&QA were presented. NASA Safety Reporting System, Space Shuttle Hazard Analysis and Failure Mode Effects Analysis/ Critical Items List were summarized. SR&QA has no constraints to STS-110.

Exceptions/Action Items

There were four CoFR Exceptions taken and no actions assigned.

Mr. Gregory polled the principal managers and organizations, and all responded ready to support the STS-110 mission.

James D. Halsell, Jr.
Colonel, USAF
Manager, Launch Integration

Enclosures:
Agenda
Exception Log

STS-110
Flight Readiness Review
March 26, 2002

Agenda

Introduction	Manager, Launch Integration
Mission Operations	Director, Mission Operations APM, Flight Operations, SFOC
EVA	Manager, EVA Project
Flight Crew	Director, Flight Crew Operations
Space and Life Sciences	Director, Space and Life Sciences
Program Integration	Flight Manager Manager, Space Shuttle KSC Integration Manager, Space Shuttle Systems Integration Manager, Space Shuttle Customer and Flight Integration APM, Program Integration, SFOC
International Space Station	Manager, International Space Station Program
Payload Processing	Director of ISS/Payloads Processing
External Tank	Manager, External Tank Project
RSRM	Manager, Reusable Solid Rocket Motor Project
SRB	Manager, Solid Rocket Booster Project APM, SRB Element, SFOC
SSME	Manager, Space Shuttle Main Engine Project
Vehicle Engineering	Manager, Space Shuttle Vehicle Engineering APM, Orbiter Element, SFOC APM, Flight Software, SFOC APM, FCE/EVA, SFOC
Ferry Readiness	Ferry Operations Manager
Shuttle Processing	Director of Shuttle Processing APM, Ground Operations, SFOC APM, Integrated Logistics, SFOC
Range	United States Air Force
DDMS	Director, DDMS
Space Shuttle SR&QA	Manager, Safety, Reliability and Quality Assurance
Exception/Action Summaries	Manager, Launch Integration
Readiness Poll	Associate Administrator, Office of Space Flight

CoFR EXCEPTION LOG

CoFR REVIEW DATE: 03-26-02

STS FLT NO. STS-110

REQUIREMENT/ EXCEPTION NUMBER	ELEMENT	DESCRIPTION OF EXCEPTION	DUE DATE
001	SSME	UCR A034462 IS OPEN. HIGH PRESSURE FUEL TURBOPUMP (HPFTP) UNIT 8027 WAS FOUND TO HAVE CONTAMINATION IN THE TURBINE COOLANT PASSAGES AFTER THE GREEN RUN TEST 902-829. TWO ACTIONS ARE IN WORK TO DEVELOP FINAL FLIGHT RATIONALE: 1. CONTAMINATION SAMPLE WAS RETURNED TO CANOGA PARK FOR ANALYSIS. ANALYSIS IDENTIFIED THE CONTAMINATION TO BE NON-METALLIC. 2. HPFTP UNIT 8027 WAS REMOVED AND RETURNED TO WEST PALM BEACH FOR DISASSEMBLY INSPECTION. DISASSEMBLY AT WEST PALM BEACH STARTED 03/26/2002.	**STS-110 PMMT**
002	ORBITER	REQUIREMENT: NSTS 08117 PARAGRAPH 8.5.18.1 "ALL ANOMALIES THAT POTENTIALLY IMPACT PROCESSING, LAUNCH, MISSION SUCCESS, OR LANDING HAVE BEEN REPORTED AND SUCCESSFULLY RESOLVED WITH NASA." EXCEPTION: A POTENTIALLY GENERIC PROBLEM HAS BEEN DISCOVERED WHERE THE LOCKING FEATURE ON THE NEW MONOBALL PRODUCTION BREAK CONNECTOR SAVERS CAN BECOME DISENGAGED DURING THE HARNESS CONNECTOR MATE PROCESS. THE LOCKING FEATURE ON FOUR OF THE CONNECTOR SAVERS BECAME DISENGAGED AFTER APPLYING AN AXIAL LOAD TO THE CONNECTOR SAVER.THIS CONDITION WILL BE RESOLVED FOR FLIGHT AND REPORTED AT THE PMMT.	**STS-110 PMMT**
003	ORBITER	REQUIREMENT: NSTS 08117 PARAGRAPH 8.5.18.1 "ALL ANOMALIES THAT POTENTIALLY IMPACT PROCESSING, LAUNCH, MISSION SUCCESS, OR LANDING HAVE BEEN REPORTED AND SUCCESSFULLY RESOLVED WITH NASA." EXCEPTION: A POTENTIALLY GENERIC PROBLEM HAS BEEN DISCOVERED WHERE THE ORBITER/ET DOOR POWER DRIVE UNIT (PDU) TORQUE LIMITERS ARE SUSPECTED OF HAVING UNDERSIZE BALL BEARINGS INSTALLED IN THE MECHANISM. THIS CONDITION COULD RESULT IN DEGRADED OUTPUT TORQUE FROM THE TWO PDUs INSTALLED ON OV-104.	**STS-110 PMMT**

CoFR EXCEPTION LOG

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REQUIREMENT/ EXCEPTION NUMBER	ELEMENT	DESCRIPTION OF EXCEPTION	DUE DATE
004	ORBITER	REQUIREMENT: NSTS 08117 PARAGRAPH 8.5.18.1 "ALL ANOMALIES THAT POTENTIALLY IMPACT PROCESSING, LAUNCH, MISSION SUCCESS, OR LANDING HAVE BEEN REPORTED AND SUCCESSFULLY RESOLVED WITH NASA." EXCEPTION: A POTENTIALLY GENERIC PROBLEM HAS BEEN DISCOVERED WHERE THE SIX BOLTS USED IN THE FUEL DISCHARGE LINE INSTALLATION ON OV-104 LH OMS ENGINE MAY HAVE BEEN OVER STRESSED DURING ASSEMBLY OF THE JOINT AT WSTF. THE RESULTS OF ANALYSIS AND TEST ACTIVITIES TO RESOLVE THIS CONDITION WILL BE REPORTED AT THE PMMT.	**STS-110 PMMT**